Towamencin Township Energy Assessment Report

Township Administration Building

1090 Troxel Road, Lansdale, PA 19446

Prepared By:

Practical Energy Solutions of West Chester, PA

Prepared For:

Towamencin Township, as part of the Delaware Valley Regional Planning Commission's *Circuit Rider for Energy Efficiency* program

APRIL 2016

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Executive Summary

The Towamencin Township administration building (16,068 ft^2) is a multiuse facility containing offices, a Council meeting space, and storage. The building is a renovated barn that opened in 2000 and is typically occupied between 40 and 45 hours per week.

From October 2011 through September 2012, Towamencin spent approximately $32,405 on energy for the administration building. Approximately 75 percent of this expense ($24,181) was for electricity, and the remaining 25 percent ($8,223) was for natural gas, which is used for space heating and domestic hot water. The annual cost of energy per square foot (sf) was $2.02.

The facility's energy use intensity (EUI)—a commonly used measure of whole-building energy performance—is 102 kBtu per sf. This is on the high end of EUI scores for similar local facilities and suggests opportunities for energy savings.

On behalf of the *DVRPC Circuit Rider Program*[1], Practical Energy Solutions (PES) performed an energy assessment of the facility to identify these opportunities. PES focused on heating, ventilation, and air conditioning (HVAC) equipment due to concerns about malfunctions, temperature imbalances, and ongoing repair bills.

The primary finding is a common one: lack of HVAC control. While the reasons for insufficient HVAC control vary from facility to facility, there are two reasons for it in this facility:

- *Inadequate thermostats*. The air handling units (AHUs)—which provide cooling, core heating, and ventilation—are controlled by digital, nonprogrammable thermostats that do not enable easy temperature setbacks during unoccupied times; and

- *Lack of temperature control*. The manual thermostats that should control the hot-water perimeter radiators appear to be malfunctioning, and other components of this system—such as valves and actuators—may also be malfunctioning. In addition, these manual thermostats do not enable automated temperature setbacks.

PES therefore recommends replacing the digital, nonprogrammable thermostats that control the air handlers with seven-day programmable thermostats and scheduling them to enter unoccupied mode during nights and weekends. Due to atypical occupancy schedules in the conference and Council meeting rooms, these thermostats should be set to unoccupied mode as a matter of course, and occupants should use a timed override, if possible, to condition the air in these rooms prior to and during events. If the thermostats don't offer timed overrides, occupants should manually override the temperature setting prior to events and reinstate the unoccupied setpoint upon leaving the room.

To address the lack of radiator baseboard control, PES recommends:
- Evaluating all valves, actuators, and wiring and replacing all defective components to ensure functionality;
- Replacing all manual thermostats with digital, programmable thermostats with locking covers;
- Scheduling all programmable thermostats so the radiators complement the AHUs by providing supplementary heat on cold days and in the mornings when needed to achieve occupied setpoints.

[1] http://www.dvrpc.org/EnergyClimate/CircuitRider/

This will cut heating energy use and should begin to address some of the HVAC repair problems that have plagued this facility.

PES also suggests an air and hot-water testing, adjusting, and balancing study to diagnose and address problems resulting from imbalanced air and hot-water distribution throughout the facility.

Additional recommendations include installing storm windows on all wood-framed windows to significantly reduce air infiltration, or having a window contractor fix all windows that no longer close properly. This measure will improve window thermal performance by about 46 percent and reduce infiltration at the window by up to 70 percent, resulting in an estimated heating energy savings of 4 percent. This issue must be addressed in order for the HVAC upgrades to produce cost savings and improve employee comfort.

If desired, the township can also install occupancy sensors in the bathrooms to reduce unnecessary lighting and ventilation fan use.

Finally, PES recommends creating a replacement plan for the six *Trane* split-system cooling units, which are nearing their end-of-service life. PES specifically recommends conducting a load-sizing study to ensure proper equipment sizes and to reduce capital costs, and installing high-efficiency units (as recommended by the Consortium for Energy Efficiency and ASHRAE 189.1-2011). Energy savings will be less than $1,000 per year, since the existing units have high-efficiency ratings. However, maintaining high-efficiency ratings when replacements are needed will help the township retain operational and budgetary efficiency.

Overall, these energy conservation measures will cut natural gas use by nearly one-third (31 percent), reduce electricity use by eight percent, and save the township approximately $4,456 in annual energy costs at today's prices (a 14 percent cost reduction). They will also reduce annual CO_2 emissions due to fossil fuel use by more than 53,000 pounds. This has the same impact on CO_2 emissions as removing nearly five passenger cars from the road per year or planting 1,127 mature trees. Table 1 provides a summary of calculated savings and paybacks.

Table 1: Summary of Energy Conservation Measures

#	Measure Description	Annual Energy Savings		CO_2 Savings [lbs]	Energy Cost Savings [$/yr]	Estimated Project Cost	Simple Payback [yrs]
1	Assess/Fix Defective Baseboard Components, Install Programmable Thermostats for AHUs and Baseboards	16,262	kWh	20,490	$3,985	$16,450	4*
		2,302	ccf	27,076			
2	Install Exterior Storm Windows or Rehang Windows	632	kWh	796	$367	$4,182^	11.4
		308	ccf	3,626			
3	Bathroom Light/Exhaust Fan Occupancy Sensors (n = 5)	964	kWh	1,214	$104	$775	7.5
	TOTAL	**17,858**	**kWh**	**53,202**	**$4,456**	**$12,107**	—
		2,610	**ccf**				

Notes: *Includes $1,950 for 6 AHU wireless programmable thermostats (at a price of $325 per thermostat installed), and $14,500 for baseboard component functionality assessment, zone valve replacements, and programmable thermostat installation. Measure #1 does not include the testing, adjusting, and balancing study, which is estimated to cost an additional $8,000 and will further reduce energy use and costs. ^Contractor quote recommended. Costs are generally estimated. Savings based on current energy rates. Savings will change as energy prices rise or fall.
Source: Practical Energy Solutions for DVRPC 2014.

Building Description

The Towamencin Township administration building (16,068 ft^2) is a multiuse facility containing offices, council meeting space, and storage. The administration building includes a renovated barn opened in 2000, with two above-grade floors, one partial below-grade floor, and an attached building that houses the council meeting room and a multiuse meeting/classroom space. The police department and a small farmhouse are on the same electricity and natural gas meters as the administration building, but they are outside the scope of this report.

The administrative offices are typically occupied between 40 and 45 hours per week, conference rooms are used for about six hours per week, and the Council meeting room is in use about 16 hours per week. The basement level is primarily used for storage and mechanical space, and it has very low occupancy.

Benchmarking and Historic Energy Use

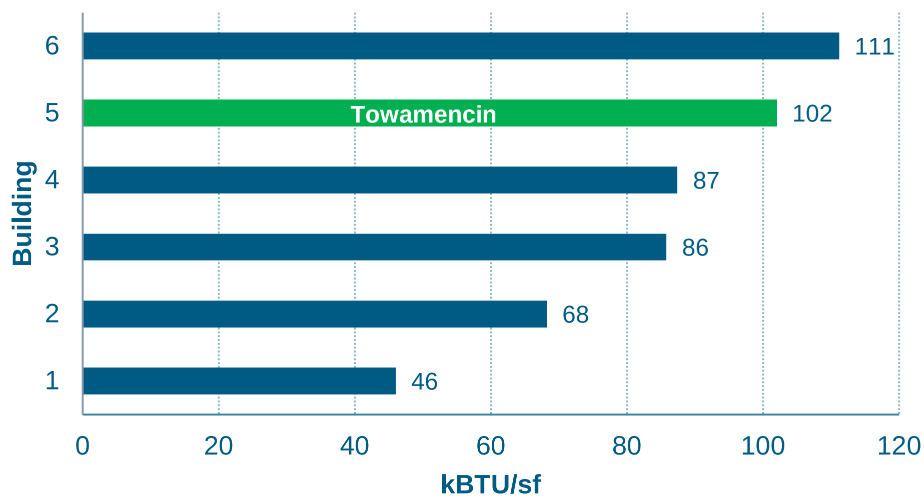
Annual Energy Costs

From October 2011 through September 2012, Towamencin spent approximately $32,405 on energy for the administration building. Energy costs for the administration building are estimated from the meters shared by the Administration Building, Farmhouse, and Police Department. Approximately 75 percent of this expense ($24,181) was for electricity, and the remaining $8,223 was for natural gas used for space heating and domestic hot water. The annual cost of energy per square foot was $2.02.

Annual Energy Use

The facility's estimated energy use intensity (EUI)—a measure of total energy use per square foot—is 102, which is on the high end of EUI scores for similar local facilities, as shown in Figure 1 below.

Figure 1: EUI Scores for Local Municipal Administration Facilities



Source: Practical Energy Solutions for DVRPC 2014

CO_2 Emissions

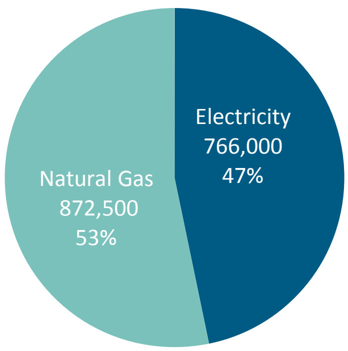
Total energy use at this facility is responsible for approximately 385,465 pounds of CO_2 emissions annually—equivalent to the annual emissions of nearly 34 passenger cars per year. Seventy-three percent of emissions were due to electricity use; the remainder were due to natural gas use.

Energy End Uses

To determine the most appropriate energy conservation measures, it is important to understand how the building systems use energy. PES developed a breakdown of energy end-uses (i.e., lighting, space cooling, ventilation fans, etc.) based on historical utility use and the site walkthrough:

- On a Btu basis, approximately 53 percent of all energy used is from natural gas, and the remaining 47 percent is from electricity, as shown in Figure 2 below.

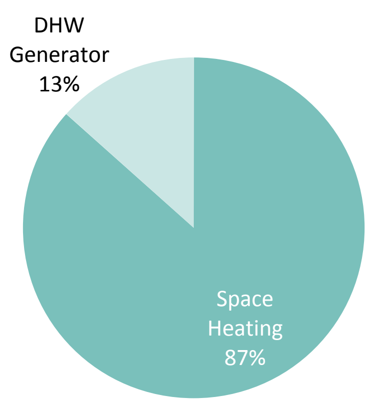
Figure 2: Energy Use in kBtu



Source: Practical Energy Solutions for DVRPC 2014

- Eighty-seven percent of natural gas is used for space heating; the remainder is used for domestic hot water (DHW), as shown in Figure 3 below.

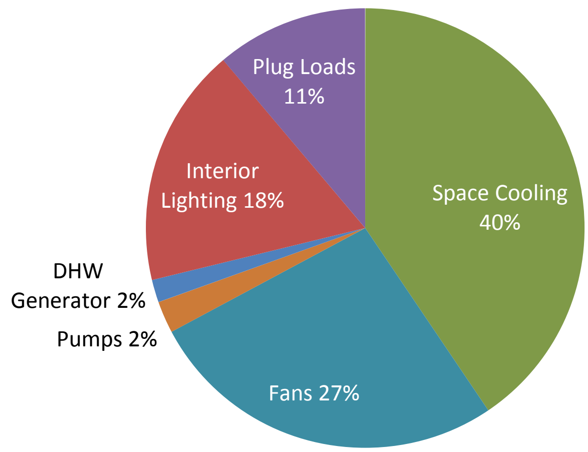
Figure 3: Natural Gas End Uses



Source: Practical Energy Solutions for DVRPC 2014

- Figure 4 shows all electricity end uses. Space cooling uses the most electricity. Ventilation fans use approximately 27 percent of electricity, and interior lighting uses just 18 percent.

Figure 4: Electricity End Uses



Notes: Plug Loads = computers, desk lamps, printers, faxes, copiers, vending machines, etc. Fans = air handlers and ventilation. **Source:** Practical Energy Solutions for DVRPC 2014

Scope of Analysis

PES performed a general walkthrough of the Towamencin administration building in March 2013, to identify opportunities to reduce energy use and costs. PES evaluated all systems but emphasized the HVAC systems due to the concerns expressed by township staff about malfunctions, temperature imbalances, and ongoing repair bills.

HVAC

HVAC: Findings

Six Trane single-zone split-system direct expansion (DX) units provide cooling and airflow. They range in size from five to 26 tons. Most are 13 years old, in good to fair condition, and offer good efficiency. The conference room unit, CU 1-4, was replaced in 2007 and is in very good condition. The older units should be considered for replacement in the near future, as they are approaching the typical 15-year service life.[2] This is evidenced in part by growing HVAC repair bills at Towamencin; during the first eight months of 2013, the township spent just under $15,000 on HVAC repairs, including one compressor replacement.

A *Weil-McLain* gas-fired boiler provides hot water to heating coils in Trane air handler units (AHUs) and to baseboard radiators, which provide perimeter heat to maintain wintertime temperatures and comfort. The AHUs and baseboard radiators are served by comingled hot-water pipes; there is no dedicated loop serving just the AHUs or the baseboards. Appendix A contains an inventory of the air-conditioning units and boiler.

[2] PA PUC Technical Reference Manual, June 2012.

The thermostatic controls for both the air conditioning and heating systems are inadequate or dysfunctional, causing energy waste and comfort problems. Specifically:

- Digital, nonprogrammable thermostats control the air handlers for both cooling and heating. Since the thermostats are not programmable, the air handlers cannot be consistently set back during evenings and weekends, resulting in unnecessary heating, ventilation, and energy use during unoccupied times.

- The perimeter hot water baseboards are controlled primarily by many individual manual thermostats located in nearly every room. Many of these thermostats, and possibly the valves and actuators as well, appear to be malfunctioning. During the site visit, some radiators were not heating despite high thermostat settings, while others were heating despite low settings. For example, PES noted one thermostat set to 72°F, but the ambient temperature reading was 60°F, as shown in Figure 5. There were similar incongruities throughout the facility.

Figure 5: Malfunctioning Manual Baseboard Thermostat

Source: Practical Energy Solutions for DVRPC 2014

In addition, the significant comfort problems and wide variances in temperatures throughout the building suggest imbalances in the air and hot-water distribution systems.

HVAC: Recommendations

AHU Thermostat Replacement

PES recommends replacing the existing digital, nonprogrammable thermostats that control the AHUs with seven-day programmable thermostats and scheduling them to enter unoccupied mode during nights and weekends. The township should consider wireless thermostats for 24-7 access to the thermostats, even when off-site. In unoccupied mode, the temperature setpoint should “set back” (in heating season) or “set up” (in cooling season) by 5°F to 10°F, and the fan should be set to cycle to maintain the unoccupied setpoint.

The Council meeting room and the conference room, which do not always follow typical weekly schedules, should be set into unoccupied mode. Occupants should use a timed override to cool and heat the rooms during events. If the thermostats don’t offer timed overrides, occupants can manually override the temperature setting and reinstate the unoccupied setpoint upon leaving the room.

Perimeter Baseboard Control

To address the malfunctioning radiators, PES recommends evaluating all valves, actuators, and wiring and replacing all faulty components. The contractor should also confirm that the transformer is working properly. Once functionality is restored, all manual thermostats should be replaced with digital programmable thermostats with locking covers, and the thermostats should be programmed carefully so they operate as intended—that is, as supplements to the AHUs on cold winter days and in the mornings, when needed to bring the building temperature to the occupied setpoint. Table 2 shows a programming recommendation.

Table 2: Recommended Thermostat Programming

	Occupied	Unoccupied
Air Handling Units (core)	70°F	60°F
Hot-Water Baseboards (periphery)	66°F	50°F

Source: Practical Energy Solutions for DVRPC 2014

Once thermostats are scheduled, lock them to maintain temperature control. Settings can be refined to meet the needs of the occupants, but the approach outlined in Table 2 should be used (i.e., set baseboards lower than AHUs, with a 4°F difference between the occupied AHU and hot-water baseboard temperatures). Allowing building occupants to change settings will defeat the design of the HVAC system while increasing energy costs and undermining comfort.

Appendix B contains a one-page job sheet for the township to deliver to contractors for bidding. The success of small municipal energy projects can depend on the client's ability to clearly communicate its needs to the contractor; this job sheet is intended to help with this process and to encourage implementation.

The success of this HVAC plan will depend on window repairs recommended in the Building Envelope section of this report. The inability to close some windows will continue to cause discomfort, and the perimeter baseboard heating repair will not be cost-effective until the windows are repaired.

Air and Hot Water Testing, Adjusting, and Balancing Study

After this project is complete, PES recommends performing a testing, adjusting, and balancing study to diagnose and address problems resulting from imbalanced air and hot-water distribution systems throughout the facility. This assessment should be performed after perimeter hot-water baseboard control is achieved, as it will also serve to verify the work performed on the radiator system and ensure that it is fully functioning with the new thermostatic controls in place. This study will further reduce energy use, potentially significantly, depending on the extent of the existing balancing problem.

Savings

Together, these measures could reduce space cooling energy use up to 18 percent and cut space heating energy use up to 29 percent as shown in Table 3 below.

Table 3: Savings: HVAC Measures

#	Measure Description	Annual Energy Savings		CO_2 Savings [lbs]	Energy Cost Savings [$/yr]	Est. Project Cost	Simple Payback [yrs]
1	Assess/Fix Defective Baseboard Components, Install Programmable Thermostats for AHUs and Baseboards	16,262	kWh	20,490	$3,985	$16,450*	4
		2,302	ccf	27,076			

Notes: *Includes $1,950 for six AHU wireless programmable thermostats (at a price of $325 per thermostat installed), and $14,500 for baseboard component functionality assessment, zone valve replacements, and programmable thermostat installation. Measure #1 does not include the testing, adjusting, and balancing study, which is estimated to cost an additional $8,000 and will further reduce energy use and costs. Savings based on current energy rates. Savings will change as energy prices rise or fall.
Source: Practical Energy Solutions for DVRPC 2014

PES recommends against storing boxes on top of the radiators, as shown in Figure 6 below. This is a safety and fire hazard and inhibits proper operation of the heating system.

Figure 6: Improper Storage of Boxes

Source: Practical Energy Solutions for DVRPC 2014

Cooling Unit Replacement Plan

PES also recommends creating a replacement plan for the six Trane split-system cooling units, since they are nearing their end-of-service life and repair bills are increasing. Rather than plan on a simple one-to-one unit replacement, PES suggests performing a load-sizing study that specifies proper boiler, AHU, and condensing unit sizing. This will ensure that replacement units will be sized properly for the occupancy demands and overall building load and will thereby minimize the township's ongoing operational energy costs while ensuring proper equipment function and comfort. By optimizing the capacities of the replacement units, the load sizing study may also help the township save on capital costs, since existing equipment may be oversized, and larger units are more expensive.

PES also recommends installing the highest possible efficiency units that will afford the township a good return on investment, as recommended by the Consortium for Energy Efficiency[3] and ASHRAE 189.1-2011. Energy savings will be minimal—an estimated $890 per year at today's electricity prices—since the existing units already have high efficiency ratings, but this will help maintain budgetary and energy efficiencies in the years to come. A proactive replacement plan will allow the township to budget for the most efficient equipment

[3]http://library.cee1.org/content/consortium-energy-efficiency-cee-high-efficiency-commercial-air-conditioning-hecac-initiativ/

possible, instead of replacing equipment upon failure. Urgent HVAC replacements are costly, and they all but eliminate the possibility of a high-efficiency replacement, as high-efficiency units are less likely to be in stock. This can force the township to purchase a standard-efficiency unit at a high-efficiency price and will lock the municipality into paying high operating costs for the 15+-year life of the new unit.

A thoughtful HVAC replacement plan (and timeline) will ensure that the township is prepared to purchase replacement units that will produce the best long-term energy and cost savings over time.

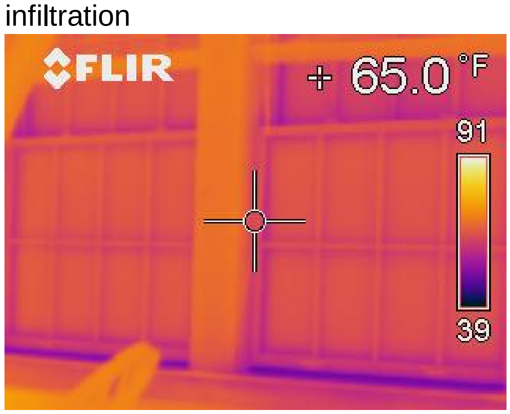
Building Envelope

PES investigated the major accessible building envelope components including exterior walls, windows, and doors. They are generally in good condition. The roof was inaccessible and was not inspected; however, it appeared from the ground to be in good condition.

Windows: Findings

Windows in private offices are double-pane, ½″ insulated units with wood frames that have good thermal insulation properties. However, many of the windows in the private offices do not close tightly, if at all. This allows unconditioned outside air to enter the building and increases heating and cooling costs. Figure 7 below shows an infrared image captured during PES' site visit. The temperature measured using an infrared camera in the circle centered in the photo is 65°F, while the temperature at the bottom seal of the window measures closer to 40°F, indicating significant air infiltration. This is the primary building envelope concern from an energy standpoint.

Figure 7: Second-Floor Office Windows, with insufficient closure and cold air infiltration



Source: Practical Energy Solutions for DVRPC 2014

Windows: Recommendation

Towamencin Township should rehang all malfunctioning windows or install storm windows on all wood-framed windows to significantly reduce infiltration. The existing windows appear to be compatible with exterior storms, which may be available from the window manufacturer for a substantially lower price than a third-party interior storm window. If not, interior storm windows are available from several manufacturers and are highly configurable for window size and operability.

This measure would improve the wood-framed windows' thermal performance by about 46 percent and reduce infiltration by up to 70 percent, and it could result in up to four percent heating energy savings as shown in Table 4 below.

Table 4: Savings: Exterior Storm Windows

#	Measure Description	Annual Energy Savings		CO_2 Savings [lbs]	Energy Cost Savings [$/yr]	Est. Project Cost	Simple Payback [yrs]
2	Install exterior storm windows (or) rehang malfunctioning windows	632	kWh	796	$367	$4,182*	11.4
		308	ccf	3,626			

Notes: *Contractor quote recommended. Costs are generally estimated. Savings based on current energy rates. Savings will change as energy prices change.
Source: Practical Energy Solutions for DVRPC 2014

Lighting

Interior lighting is primarily 48″, 32W T-8 linear fluorescent tubes in two-lamp suspended fixtures. This is an energy-efficient configuration, and employees are satisfied with light output. This facility also receives abundant natural daylight, and many lights were turned off on the day of the site visit. This is an excellent way to manage lighting energy use.

Township employees noted that bathroom lights are often left on when unoccupied and requested an investigation. Each bathroom has a small exhaust fan that is interlocked with the light switch, so when lights are left on, the fan also runs. Towamencin Township can consider installing occupancy sensors in each bathroom to automatically turn off the lights and exhaust fan when the bathrooms are vacant. This could reduce electricity costs by more than $100 per year and will also produce minor heating savings, since less conditioned air will be exhausted from the building, as shown in Table 5 below.

Table 5: Savings: Bathroom Occupancy Sensors

#	Measure Description	Annual Energy Savings [kWh]	CO_2 Savings [lbs]	Energy Cost Savings [$/yr]	Estimated Project Cost	Simple Payback [yrs]
3	Light/Exhaust Fan Occupancy Sensors in Bathrooms	964	1,214	$104	$775	7.5

Notes: Savings based on current energy rates. Savings will change as energy prices change.
Source: Practical Energy Solutions for DVRPC 2014

Appendix A

Appendix A. Inventory of the Air Conditioning Units and Boiler

Designation	Description	Services	Make/Model	Year	Existing				Recommended	
					Cooling		Heating		Cooling	Heating
					Capacity [Btuh, HP]	Efficiency [EER]	Capacity [Btuh]	Efficiency [AFUE]	Efficiency [EER]	Efficiency [AFUE]
B-1	HW Boiler	AHUs, Rads	WM P-688-W	2001	-	-	1,358,000	80%		94%
IT-1	Split Sys CU	IT	Mitsubishi MU12TN/MS12TN	2001	12600	11.2				
IT-1	Split Sys CU	IT	Sanyo C2672R	2000	24800	8.5				
CU 1-1a	Outdoor CU	Basement	Trane TTA120A400CA	2000	128,000	10.3			12	
CU 1-2	Outdoor CU	1st Floor	Trane TTA120B400CA	2000	126,000	10.3			12	
CU 1-3	Outdoor CU	2nd Floor	n/a	2000	*240,000**	*10.3**			10.6	
CU 1-4	Outdoor CU	Conference Room	Trane XR13 2TTR3060A 1000AA	2007	60,000	11.5			12	
CU 2-1	Outdoor CU	Council Meeting Rm	Trane RAUCC254BT03000000020	2000	314,000	11.1			10.6	
CU 2-2	Outdoor CU	Meeting Rm Lobby	same as CU 1-3	2000	*240,000*	10.3			10.6	
AHU 1-1a	Indoor AHU	Basement	Trane MCC Size 06	2000	2	-				
AHU 1-2	Indoor AHU	1st Floor	Trane MCC Size 10	2000	3	-				
AHU 1-3	Indoor AHU	2nd Floor	Trane MCC Size 10	2000	3	-				
AHU 1-4	Indoor AHU	Conference Room	Trane MCC Size 3	2000	1	-				
AHU 2-1	Indoor AHU	Council Meeting Rm	Trane MCC Size 12	2000	5	-				
AHU 2-2	Indoor AHU	Meeting Rm Lobby	Trane MCC Size 6	2000	2	-				

Notes: HW = hot water. CU = condensing unit. AHU = air handling unit. *Estimated. ^Recommendations should be checked for updates prior to unit specification/replacement. Use most up-to-date efficiency ratings. See: http://library.cee1.org/sites/default/files/library/5347/CEE_CommHVAC_HECAC__InitDescip.pdf
Source: Practical Energy Solutions for DVRPC 2014.

Appendix B

Appendix B. HVAC Job Sheet

Towamencin Township Administration Building Hot Water Baseboard Repair Plan

The intent of this project is to gain control over the hot-water baseboard radiators in the Township Administration facility.

Existing Conditions

Currently, each baseboard radiator has an electric zone valve wired to a manual thermostat. In nearly every case, the controls are dysfunctional; some radiators run despite low thermostat settings, while others do not run despite high thermostat settings. The lack of control could be due to a number of factors—including broken thermostats, faulty wiring, dysfunctional valves and actuators, and/or a problematic transformer, although a transformer problem is unlikely in this case.

Project Scope

To correct the problem, the following steps should be taken:

- Evaluate all valves, actuators, and wiring to ensure functionality. If needed, ensure functionality of transformer;
- Replace all faulty valves, actuators, and wiring;
- Replace all manual thermostats with *digital programmable thermostats with locking covers* (n = 24). Ensure that all AHUs also have digital programmable thermostats with locking covers;
- Schedule all programmable thermostats carefully. The intent of the hot-water radiators is to complement the air handling units (AHUs), which act as the primary heat source for the core of the building. The radiators provide supplementary heat on cold days when the AHUs cannot keep up with heating demands and in the mornings when needed to bring the temperature up to setpoint. Therefore, the baseboard thermostats should be set at temperatures below those of the AHUs, using an approach similar to the following:

	Occupied	Unoccupied
Air Handling Units (core)	70°F	60°F
Hot-Water Baseboards (periphery)	66°F	50°F

- Once thermostats are scheduled, lock all thermostats to maintain temperature control. Settings can be refined to meet the needs of the occupants, but the same approach outlined above should be used (i.e., set baseboards lower than AHUs, with a 4°F difference between the occupied AHU and hot-water baseboard temperatures). Allowing building occupants to change settings will defeat the purpose of the project and can greatly increase energy costs, while undermining comfort.

Towamencin Township Energy Assessment

Township Administration Building

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Key Words:

Energy, natural gas, electricity, energy management, heating ventilation air conditioning (HVAC), boiler, thermostat, baseboard, envelope, windows, lighting, CO_2 emissions

Abstract:

On behalf of the DVRPC Circuit Rider Program Practical Energy Solutions (PES) performed an energy assessment of the Towamencin Township Administration Building. The Towamencin Township administration building (16,068 ft^2) is a multiuse facility containing offices, a Council meeting space, and storage. The building is a renovated barn that opened in 2000 and is typically occupied between 40 and 45 hours per week. PES's energy assessment work focused on heating, ventilation, and air conditioning (HVAC) equipment due to concerns about malfunctions, temperature imbalances, and ongoing repair bills. PES observed insufficient HVAC control at this facility due to inadequate thermostats and a lack of temperature control. Recommendations included installing digital programmable thermostats and specific recommendations to conduct a more in depth evaluation of the building's radiator baseboard controls and balance issues by the Township's HVAC contractor. Additionally, PES recommended that township develop an HVAC replacement plan for the HVAC units that are nearing the end of their service life, and repairing the building's wood-frame windows in order to reduce air infiltration. Overall, these energy conservation measures will cut natural gas use by nearly one-third (31 percent), reduce electricity use by eight percent, and save the township approximately $4,456 in annual energy costs at today's prices (a 14 percent cost reduction). These measures will also reduce annual CO_2 emissions due to fossil fuel use by more than 53,000 pounds annually.

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